

FY 19 Research Program Impact Report



Supporting INDOT's Strategic Objectives: Safety, Mobility, Economic Competitiveness, Customer Service, Asset Sustainability, Organization & Workforce, and Innovation & Technology



FY 19 Research Program Impact Report

Introduction:



- INDOT/JTRP Research Program is an **established** state DOT Research Program that has partnered with practioners, academia, and industry **since 1937** to address Indiana's transportation needs and challenges.
- The program has **realized significant achievements** over the years and each year provides two reports highlighting the quantitative and qualitative benefits delivered by the program.
- **Return on Investment (ROI) report** quantifies the cost savings to customers (user costs and safety) and to INDOT (departmental savings).
- This **IMPACT report** describes the qualitative benefits derived from the program.
- Both reports provide a comprehensive snapshot of the many **benefits** from the INDOT/JTRP Research Program.



FY 19 Research Program Impact Report

Introduction:

2. Indiana



- Many state DOTs have **modeled their state research programs after the Indiana program**. The program has also received national recognition for its impact on national transportation issues.
- In 2019, **INDOT** unveiled its updated **Strategic Plan**. Strategic Objectives included: **Safety, Mobility, Economic Competitiveness, Customer Service, Asset Sustainability, Organization & Workforce, and Innovation & Technology**.
- The Research Program provides **direct support** to the **Strategic Plan** for INDOT to fulfill its **Strategic Objectives** outlined in the Strategic Plan. This IMPACT report highlights **projects completed in FY 2019** that impact the 2019 INDOT Strategic Plan.
- Additional accomplishments are also included such as awards, specialized testing programs, performance metrics, continuous improvement initiatives, and forensic investigation program.



FY 19 Research Program Impact Report

Supporting INDOT's Strategic Objectives: Safety, Mobility, Economic Competitiveness, Customer Service, Asset Sustainability, Organization & Workforce, and Innovation & Technology

Strategic Plan Impact Areas:

- Safety & Mobility
- Asset Sustainability
- Innovation & Technology and Economic Competitiveness
- Customer Service and Organization & Workforce

Other Program Impact Areas:

- Engagement & Networking
- State and National Recognitions
- Forensic Investigations and Specialized Testing Programs
- Program Metrics & Venues for Continuous Improvement
- Resources & Links



NextLevel
INDIANA



Your investment
is having IMPACT

PROJECT
impact
give. serve. make an impact.

Strategic Plan Impact Areas – Safety & Mobility

SPR-3821, Real Time **Mobility Traffic Measures** (Mobility Reports, traffic signal timing, utilization of probe data)

SPR-4103, Developing the **Collision Diagram Builder**

SPR-4104, Predicting Impact to Traffic Safety and Mobility of **Change in Speed Limits** for Indiana Freeways

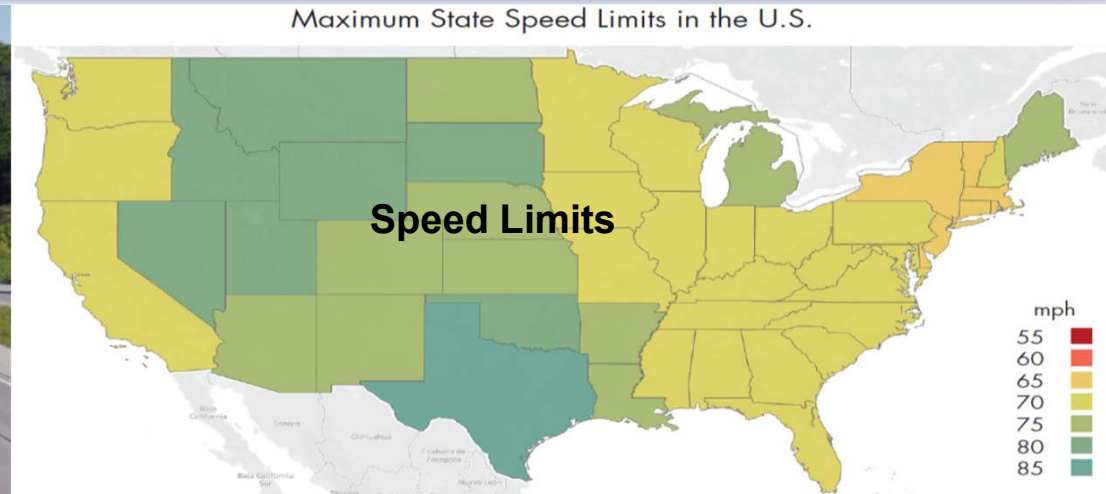
SPR-4113, Development of a **Friction Performance Test** for Compacted Asphalt Mixtures

SPR-4126, Implementation of LiDAR-Based Mobile Mapping System for **Lane Width Evaluation and Reporting in Work Zones**

SPR-4155, Updating **Asset Risk and Vulnerability Assessment**



Strategic Plan Impact Areas – Safety & Mobility



Strategic Plan Impact Areas – Asset Sustainability

SPR-3807, Investigating the Need for HMA **Drainage Layers**

SPR-3815, Modeling **Standards for Bridges and Culverts**

SPR-3904, **Tack Coat Installation** Performance Guidelines

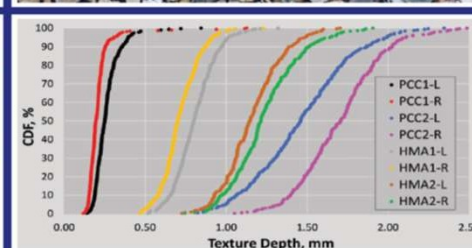
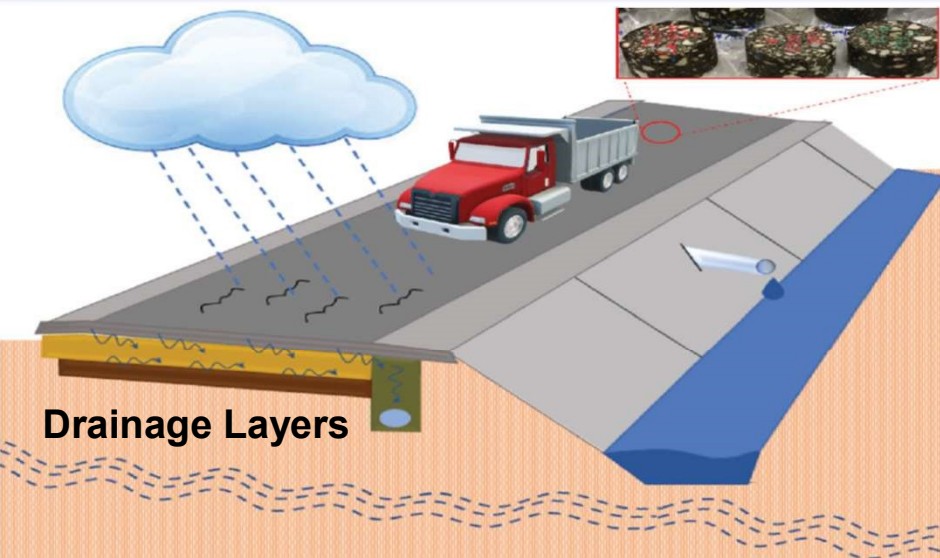
SPR-3905, **Concrete Patching** Materials, Techniques & Guidelines for Hot Weather Concreting

SPR-4119, Assessment of **Bridges Subjected to Vehicular Collision**

SPR 4157, **Quality Assurance Procedures for Chip Seal Operations**
Using Macrotexture Metric



Strategic Plan Impact Areas – Asset Sustainability



Strategic Plan Impact Areas – Innovation & Technology & Economic Competitiveness

SPR-3912, Economic Development Impact of Corridor Improvements and Preservation Projects

SPR-3945, Virtual Construction Inspection Technology

SPR-4002, Risk-based Specification for Construction

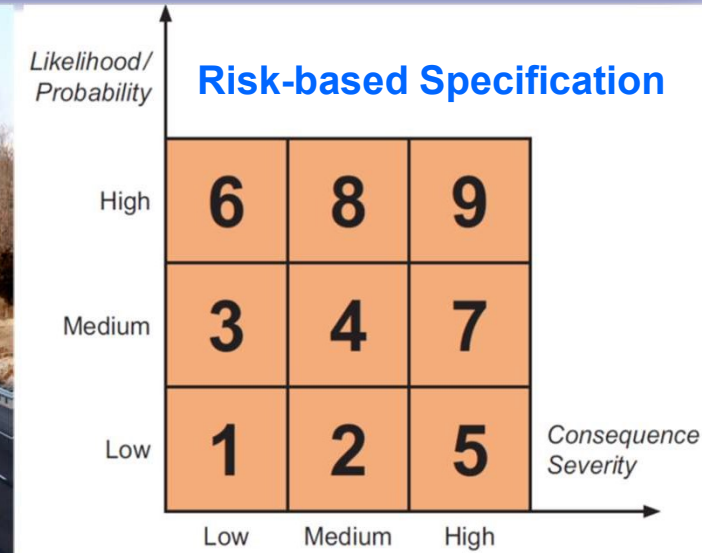
SPR-4005, Warranty Utility Cut Repair (QC/QA of Utility Cut Repair)

SPR-4225, INDOT Research Program Benefit Cost Analysis – Return on Investment (ROI)

SPR-4017, WIM Data Quality Control and Real-Time Dashboard Development



Strategic Plan Impact Areas – Innovation & Technology and Economic Competitiveness



Strategic Plan Impact Areas – Innovation & Technology and Economic Competitiveness

SPR-4100, Maximum Allowable Deflection by **Light Weight Deflectometer** and Its Calibration and Verification

SPR-4123, Strategic and Tactical Guidance for **the Connected and Autonomous Vehicle** Future

SPR-4156, Capital Program Cost Optimization through Contract Aggregation Process (**Projects Bundling**)

Damage Wise Implementation (the time from crash to billing was less than one month, the amount invoiced increased to more than \$10 Million and 90% of the collections were distributed back to the districts for remedy).

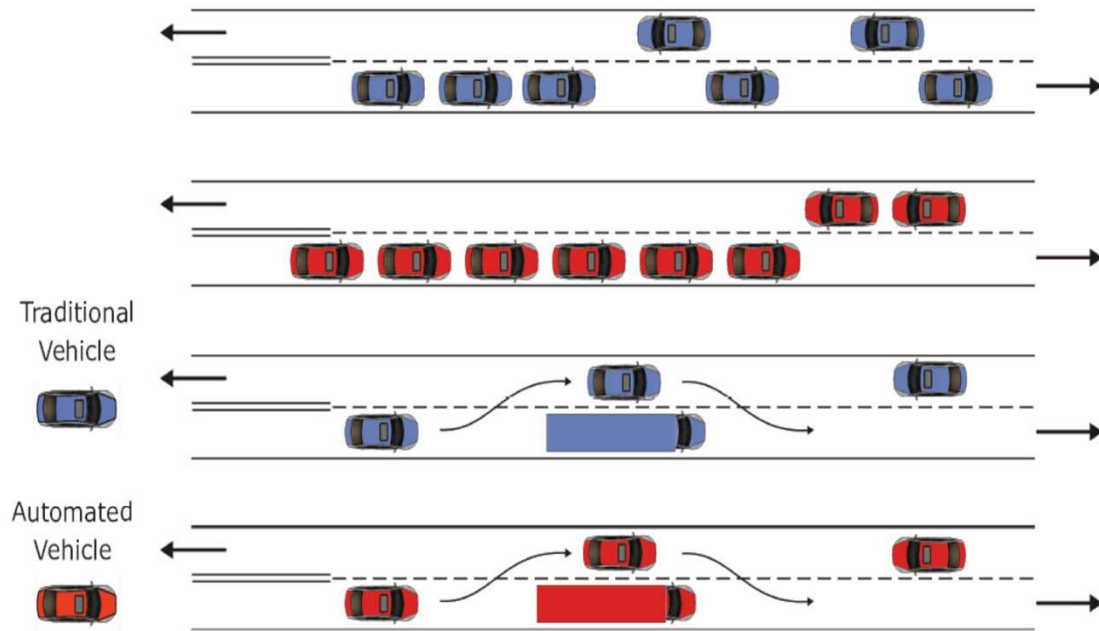
INDOT participated in a **pooled fund study** on effect on capacity of freeways, 2-lane highways, arterial streets, and intersections of connected automated autonomous, vehicles; and on expected adoption & penetration rates.



Strategic Plan Impact Areas – Innovation & Technology & Economic Competitiveness



Rural Two-Lane Highways



Capacity Implications
Of Connected and Autonomous Vehicles



Strategic Plan Impact Areas – Innovation & Technology & Economic Competitiveness

INDOT participated in numerous Usages of **High Resolution LIDAR** for Transportation Asset & Inventory Management

Posted in June (Inside INDOT) - **Precast Concrete** is used in US 40 (to maintain tolerance for underpasses & reduce road closure time)

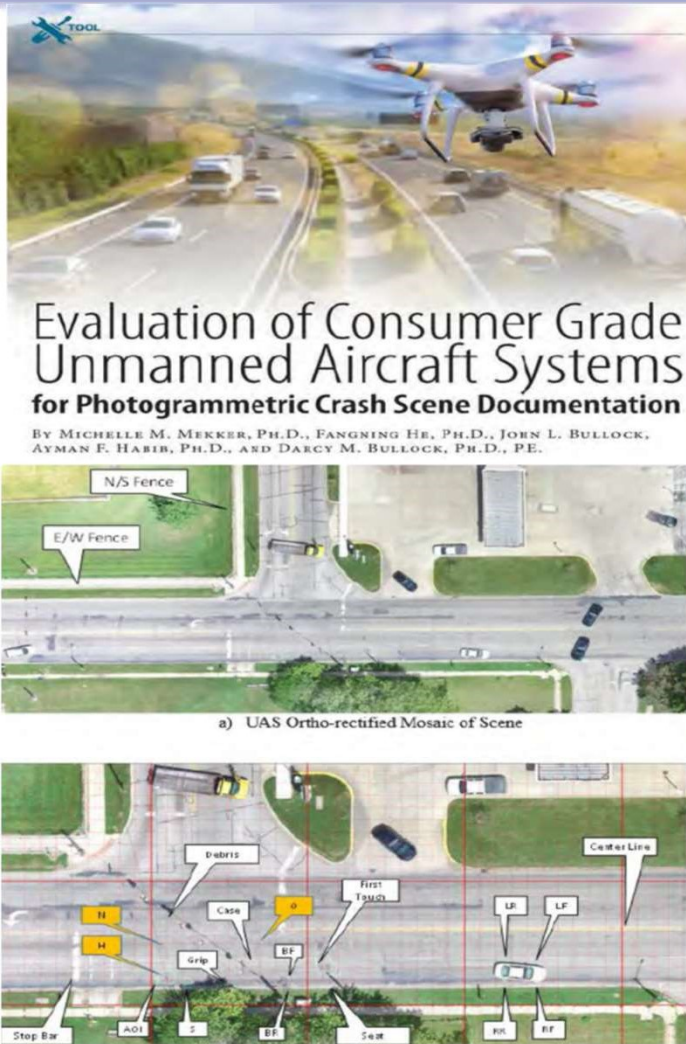
Posted in July (by Inside Edge, Inside Indiana Business) Discovery Park to lead new **Innovation Hub for Connected and Autonomous Transportation Technologies**

Evaluation of **Consumer Grade Unmanned Aircraft Systems (UAS)** for Photogrammetric Crash Scene Documentation – ite journal, July

Posted in October (by INRIX) – **INDOT Case Study**: How applied research is guiding a new generation of transportation management solutions



Strategic Plan Impact Areas – Innovation & Technology & Economic Competitiveness



Strategic Plan Impact Areas – Customer Service and Organization & Workforce

SPR-3852, Transportation Research Board (**TRB**) Annual Meeting Activities

SPR-4158, Implementation of **Continuous Improvement** for INDOT **Maintenance** (Training and Tracking Process Improvements)

SPR-4203, Synthesis Study: **Facilities (Enterprise Development, Sponsorship & Privatization)**

SPR-4229, Cost Effectiveness of Constructing Minimal Shelter to Store INDOT Equipment (Weather Protection)

SPR-4333, Telematics and Utilization Analysis for INDOT Mowing Operations



Strategic Plan Impact Areas – Customer Service and Organization & Workforce



2019 TRB
Annual
Meeting



Implementation of
Continuous
Improvement



Minimal Shelter
to Store INDOT
Equipment



Analysis for INDOT
Mowing Operations

Strategic Plan Impact Areas – Customer Service and Organization & Workforce

S-BRITE, bridge inspection/training/certification/other activities

UAS Applications Implementation

Advanced **Pavement Training** for District and CO Pavement Engineers

INDOT **EVOLVE**, Purdue/JTRP Events

INDOT staff serving as **business owners/SAC** with faculty, practitioners, other DOT staff. INDOT staff indicates positive professional development from SAC engagement



Strategic Plan Impact Areas – Customer Service and Organization & Workforce



Other Program Impact Areas - Peer Exchange, Every Day Counts (EDC) & SHRP 2 (National IMPACTs)

Organized October 16 – 18, 2018 Peer Exchange for the Research Program Focusing on **“Transformational Technologies”**

Partnership with FHWA in EDC Initiatives

Facilitated **10 Innovations in EDC 5** (INDOT advanced 5, 4 institutionalized already and 1 not advanced). LTAP support for 2 of these institutionalized.

Participated in National STIC Meetings (April 11& October 24, 2019).

\$480K STIC Incentives leveraging 5 INDOT studies.

Pooled Fund Studies, PFS. INDOT participated in the PFS “Effect on capacity of freeways, 2-lane highways, arterial streets, and intersections of connected automated autonomous, vehicles; and on expected adoption & penetration rates”

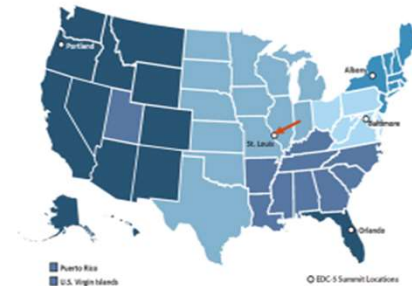


Other Program Impact Areas - Peer Exchange, Every Day Counts (EDC) & SHRP 2 (National IMPACTs)



EDC – 5 Regional Summit in St. Louis Missouri

No.	Host City	Dates
1	Baltimore	October 18-19
2	St. Louis	October 29-30
3	Albany	October 24-25
4	Portland	November 8-9
5	Orlando	November 27-28



1. Mir Zaheer
2. Mark Bailey
3. Roy Nunnally
4. Martin Blake
5. Anne Rearick
6. Jim Sturdevant
7. Louis Feagans
8. Rickie Clark
9. Lyndsay Quist,
10. Jim Poturalski



Every Day Counts EDC – 5 Innovations

1. **ADVANCED GEOTECHNICAL EXPLORATION METHODS**
2. **COLLABORATIVE HYDRAULICS: ADVANCING TO THE NEXT GENERATION OF ENGINEERING (CHANGE)**
3. **PROJECT BUNDLING**
4. **REDUCING RURAL ROADWAY DEPARTURES**
5. **SAFE TRANSPORTATION FOR EVERY PEDESTRIAN (STEP)**
6. **UNMANNED AERIAL SYSTEMS (UAS)**
7. **USE OF CROWDSOURCING TO ADVANCE OPERATIONS**
8. **VALUE CAPTURE: CAPITALIZING ON THE VALUE CREATED BY TRANSPORTATION**
9. **VIRTUAL PUBLIC INVOLVEMENT**
10. **WEATHER-RESPONSIVE MANAGEMENT STRATEGIES**



Other Program Impact Areas – Engagement & Networking

JTRP Meeting and Demonstrations at Purdue **ACRE facility**

Crawfordsville Leadership Visit to INDOT R&D August, 2019

Valeo Tour and Valeo campus visit

Aptive and **Delphi Visits** and **COMVEC** communication for a near term opportunity in Indiana

Industrial CAV Campus Engagements (**Ford, VW, Cummins, 3M**)

Participating & Winning the second annual Governor's State Employees' **3-on-3 Basketball Tournament**.
(Inside INDOT, October 2019)

INDOT & LTAP demos for **calibration for liquid routes**

TRB Annual meeting (presentations, papers, posters)

February 13, 2018, **Poster Session**/Board Meeting at IGCS

NCHRP, TRB, AASHTO Committees membership

LiDAR and Photogrammetry for Construction (**DC Roland Fegan Campus Visit**)

SPD/HR and Safety Director site visit (October 3, 2019)

Innovation Director site visit (May 17, 2019)



Other Program Impact Areas – Engagement & Networking



Other Program Impact Areas – Engagement & Networking



Valeo Site Visit



Traffic Signal Performance Measures



Other Program Impact Areas – State & National Recognition

ERIN articles, Inside INDOT newsletter articles

- INDOT Uses **New Technology to Design Safer Roadways** (Inside INDOT article, September 2019)
- **Lean Workshops** Help Shape Up INDOT's Processes
- Special **raised pavement markers** (RPMs), will be installed along U.S. 20 pavement.
- **Prototype Trailer** Puts Us Ahead in Innovation (Inside INDOT article June 2019)
- New **LED Lights** Brighten up INDOT's Roadways, One District at a Time. (December 2019)
- INDOT Smartly Explores the Use of **Unmanned Aircraft**.
- Forget the S&P: **INDOT's Research Program Has Huge ROI**
- **INDOT's Research Program Becomes Ultra-Popular**



Other Program Impact Areas – State & National Recognition

INDOT Uses New Technology to Design Safer Roadways

The culture of safety isn't lost on INDOT's highway designers; more and more, they are using cutting-edge technology to design the safest roads possible within budget.

Designers' latest instrument is the Interactive Highway Safety Design Model (IHSDM), a suite of software analysis tools for evaluating safety and operational effects of geometric design in the highway project development process.

"The IHSDM is intended as a supplementary tool to augment the design process," said Senior Highway Engineer Abell Gelaye, who works in the Highway Design & Technical Support Division at Central Office. "The tool is not a substitute for engineering judgment, but it can help predict the functionality of designs by applying data and guidelines to predict performance of the design for today and the future."

The IHSDM supplements the Highway Safety Manual (HSM) in the form of evaluation modules. The HSM is published by the American Association of State Highway and Transportation Officials (AASHTO) and is the result of collaborative work with the Federal Highway Administration and Transportation Research Board.

The IHSDM features six modules, each of which evaluates a geometric design from a different perspective and estimates measures describing one aspect of the expected safety and operational performance of the design. The modules are:

- **Crash Prediction Module:** Provides estimates of predicted crash frequency and severity. (Users may also run economic analysis using this module.)
- **Design Consistency Module:** Estimates expected operating speeds and measures of operating-speed consistency.
- **Intersection Review Module:** Enables a systemic review of intersection design elements.
- **Policy Review Module:** Checks a design relative to the range of values for critical dimensions recommended in AASHTO Green Book design policy.
- **Traffic Analysis Module:** Estimates measures of traffic operations used in highway capacity and quality of service evaluations.
- **Driver/Vehicle Module:** Evaluates how a driver would operate a vehicle within the context of a roadway design and functional classification of the highway.



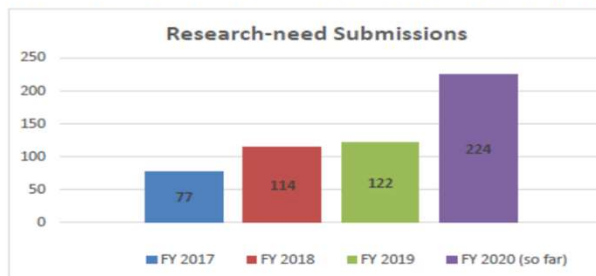
The IHSDM enables INDOT designers to create alternatives, each with their own crash reduction data.

"The highway network is getting older, and safety is a top priority as we replace elements of the network," said Gelaye. "Stakeholders are expecting safer highways within the same budget, and the IHSDM has a cost-effectiveness feature. The combination of safety and cost-effectiveness make the IHSDM ideal to check designs for unsafe features,

INDOT's Research Program Becomes Ultra-Popular

Like ascending fireworks, research needs at INDOT have been skyrocketing.

INDOT's Research & Development (R&D) Division received 114 research-need submissions in Fiscal Year (FY) 2018, up from 77 in FY 2017. For the FY 2019 program, 122 research needs were submitted, and 224 needs have been submitted already for the FY 2020 research program. Of the FY 2018 submissions, 46 projects have already been started.



"The increase in needs submitted is a reflection of the impact and breadth of the program," said R&D Director Barry Partridge.

R&D touches virtually all of INDOT. Research projects run the gamut — from LiDAR applications for safety, new lighting technologies, and the performance of alternative diamond interchanges to bridge preservation treatments, the use of slag aggregates and slag cements, and unmanned aircraft systems uses.

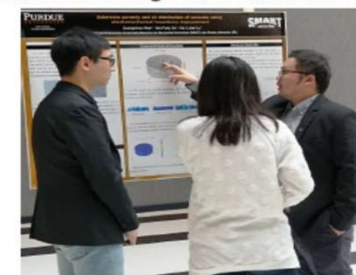
Every year in January and February, the value of the R&D program comes to light with the:

- Hosting of an INDOT Research Program Innovation Fair
- Publication of a Return on Investment (ROI) Report
- Publication of a fiscal-year IMPACT Report

Research Program Innovation Fair

R&D supports rising stars — PhD candidates from Indiana colleges and universities — who display poster synopses of their transportation research during the Innovation Fair in the Indiana Government Center South Atrium.

This year's fair, co-hosted by the Purdue Joint Transportation Research Program (JTRP), took place Feb. 13. Hundreds of INDOT employees joined industry leaders, state and federal officials, and faculty members of Indiana colleges and universities to discuss current research and innovative transportation technologies with the researchers. Among the



A poster involving the porosity and air distribution of concrete draws attention.

Other Program Impact Areas – State & National Recognition

INDOT Smartly Explores the Use of Unmanned Aircraft

The use of Unmanned Aerial Systems (UAS) is rising across the world, and INDOT is keeping pace through its UAS Advisory Committee.

"UAS technology — with capabilities such as aerial photogrammetry, survey applications, LiDAR, and all the nondestructive methods of looking at pavement, bridges and airport obstructions — has really taken flight," said Office of Aviation Manager Marty Blake. "We've proactively formed an advisory committee to position INDOT to be right alongside that technology with trained personnel and business rules so that we can take advantage of these advances."

UAS forces are also known to the general public as unmanned aircraft, or drones. However, INDOT and other governmental entities, such as the Federal Aviation Administration (FAA), always avoid using the term "drone," as it evokes thoughts of the military or futuristic action movies.



INDOT Office of Aviation staff members maneuver a large unmanned aircraft from the ground (top photo) to the air (bottom photo).



The committee has met since late fall 2018 and will continue to evaluate and prioritize UAS business use while creating an effective UAS Aviation program under FAA regulations. In early 2019, the Office of Aviation conducted a request for information for how to implement a UAS program for a state agency. Thirteen companies responded.

"We're using that guidance — along with Joint Transportation Research Program (JTRP) research through policy, our own internal aviation knowledge, and the findings of the UAS Advisory Committee — to come up with a UAS program for the agency," said Blake. "But we have to do it smartly, we have to do it safely, and we have to do it legally."

Blake leads the committee, which consists of INDOT leaders from Construction, Capital Program Management, Bridges, Design, Highway Design, Land & Aerial Survey, Multimodal, Legal, Technical Services, Major Projects, and Broadband Corridor.

During the next 12 months, they will consider the state's current resources, research projects, certified pilot resources, and required training programs to develop an effective, safe and efficient utilization of UAS within the guidance of federal regulations. They will also augment and streamline INDOT's normal and emergency operations.

New LED Lights Brighten Up INDOT's Roadways, One District at a Time

Motorists in the Greenfield District have a clearer view of the road thanks to a near-complete switchover from high-pressure sodium (HPS) lighting to light-emitting diode (LED) luminaires on the district's interstates and highways. Similar changes will soon follow in INDOT's five other districts.



At the rest area near Greenfield, the white color from solid-state lighting is contrasted with orange-yellow light from HPS fixtures (both photos provided by DOT Lighting).



"The combination of the lighting industry improving their products, along with our research and testing, prompted the change," said Traffic Administration Manager Dave Boruff. "INDOT's highway lighting will now be more energy efficient and will require less maintenance. Additionally, motorists and workers will be safer since they will have clearer views of the road."

LED is one type of solid-state lighting, the development of which was prompted by a U.S. Department of Energy (DOE) initiative a decade ago. The home market responded first with energy-efficient lightbulbs. Then, the DOE issued large grants to municipalities and their utility companies to convert from the previous type of light source technology to more energy-efficient types like LED. Established companies like General Electric Acuity Brands, and Phillips took notice, and so did start-up firms. Soon, they solicited INDOT with their new solid-state products.

"In the period from 2009 to 2012, more than 50 manufacturers approached us with various solid-state products such as LED, light-emitting plasma, ceramic metal halide, and a type of lamp that is electrodeless but uses magnetic induction," said Boruff. "The initial claim from industry was that by using their product, our energy consumption would be cut by as much as 90%, and lights would be maintenance free for 25 years."

Other Program Impact Areas – State & National Recognition

ERIN articles, Inside INDOT newsletter articles

- **Quality Assurance Methods for Subgrade Construction** Treatment, 2019 Road School
- INDOT is a significant partner in a new **innovation hub (for Connected and Autonomous Transportation Technologies)** that is receiving national attention
- District Tests **friction of surfaces sealed with Scrub-Sealing** Process employing Different Emulsions
- **Video-Equipped Robots Tell Us What Lurks within Small Drainage Pipes** (Inside INDOT article, May 2019)
- **Damage-Wise** enables INDOT to seek reimbursement for repair costs from vehicle drivers or their insurance.
- **Damage to State Property Team Honors State Troopers**
- Presentation at the AASHTO Maintenance Committee Summer Meeting: “**Leveraging Telematics and Weather Data to Study the Productivity of Roadside Mowers**” (July 2019)
- NCHRP 889: Performance Measures in **Snow and Ice Control Operations**



Other Program Impact Areas – State & National Recognition

District Tests Scrub-Sealing Process with Different Emulsions

Scrub-a-dub-dub, the Crawfordsville District is conducting tests to see how scrub sealing with different oil emulsions affects the roadway.

Scrub sealing is similar to chip sealing, but a scrubber with bristles is attached to the back of the sealant application truck. As emulsion is sprayed, broom bristles push the materials into cracks before aggregate stone is laid down. The emulsion/scrubbing process seals the road up to prevent water from getting into the pavement, and the stone provides friction. Scrub sealing is most effective on roads with numerous cracks.

Although scrub sealing is officially included in the INDOT Work Performance Standards, we have done it only a few times in the LaPorte and Vincennes districts. Crawfordsville District Highway Maintenance Director Clint Bryant thought of an ideal way to bring scrub sealing to his district while at the same time conducting more research on the process.

"My idea was to scrub seal a road, but use two different emulsions to see which one does a better job," said Bryant. "That's precisely what we're doing on State Road 63 in rural Vermillion County."

During the scrub-sealing process, the scrubber is attached to the back of the sealant application truck (top photo) so that the broom bristles can push emulsion into cracks in the pavement (bottom photo).



In September, INDOT forces closed off five miles of the northbound driving lane of the four-lane State Road 63 between State Road 32 and I-74. For the first 2½ miles, we laid down the standard AE-90S chip seal emulsion, scrubbed it, and topped it with stone. For the second 2½-mile segment, we used a latex-infused emulsion before scrubbing it and topping it with the same type of stone. To watch a video of the process, click [here](#).

At first glance, Bryant said, he could see the pattern of broom

ERIN Employee Resource Internal News

(Posted Aug. 2, 2019) Research really does pay off. So do commitment, partnerships, and diligence.

INDOT's DamageWise program has exhibited these characteristics since it first was full implemented nearly a decade ago. Now, DamageWise is a nationally known program, and was featured in the May-June 2019 issue of TR News, a prestigious bimonthly magazine of the Transportation Research Board. The magazine features timely articles on innovative and state-of-the-art research and practice in all modes of transportation.

Each issue includes a Research Pays Off section, which is where DamageWise was featured.

"This was a nice, glossy piece that did a great job at describing our program, its history, and its breadth involving law enforcement, the districts, collections, and more," said Chief Financial Officer Dan Brassard.



Research Pays Off
INDOT's DamageWise program has exhibited these characteristics since it first was full implemented nearly a decade ago. Now, DamageWise is a nationally known program, and was featured in the May-June 2019 issue of TR News, a prestigious bimonthly magazine of the Transportation Research Board. The magazine features timely articles on innovative and state-of-the-art research and practice in all modes of transportation.

DamageWise is featured in TR News (above photo); the program includes the use of pink tags (bottom photo) affixed to damaged state property.



DamageWise enables INDOT to seek reimbursement for repair costs from vehicle drivers or their insurance companies regarding crash-damaged highway infrastructure or INDOT-owned vehicles and equipment. Of the approximately 60,000 motor vehicle crashes per year that occur on state-maintained roads, about 4,000 — or 6.6 percent — of them cause damage to state property, such as guardrails, cable barriers, signs, and bridges.

INDOT supplies Indiana State Police and other law enforcement agencies with bright pink tags to affix to this damaged state property; these tags associate crash-damaged infrastructure to a specific police crash report.

The TR News article was written by Brassard and the Joint Transportation Research Program's Darcy Bullock and Deborah Horton. It chronicles the original research from 2009 that reviewed business processes of law enforcement agencies, and INDOT district maintenance and collection departments.

The story then delves into team participation from district maintenance crews and supervisors, Central Office finance personnel, and information technology departments, as well as interagency partnerships with public safety and law enforcement colleagues. It describes the genesis of the pink-tag system used by law enforcement, financial claim tracking, implementation costs, and ongoing costs and benefit-cost ratio.

"The development of a training and outreach program to

Peter Becker on Quality Assurance Methods for Subgrade Treatment Construction at Purdue Road School



Other Program Impact Areas – State & National Recognition

TRB Awards & High-Profile Articles

- TRB Research Pays Off, “**Damage-Wise** Program Implementation Pays Off for Indiana,” *TR News*.
- “Using Connected Vehicle Data to Reassess Dilemma Zone Performance of Heavy Vehicles” winner of the **TRB Best Paper Award**.
- “Ontology-Based Knowledge Management System for **Digital Highway Construction Inspection**,” winner of the TRB, K. B. Woods Award.
- “**Bundling Bridge and Other Highway Projects: Patterns and Policies**,” Best paper award from TRB (D. Grant Mickle Award)
- Best Paper award for TRB “**Evaluating Construction work zone Employing LiDAR**”.
- **Concrete Sensor Research**, Inside Indiana Business TV interview with Prof. Luna Lu (December 12, 2019)
- August 28, 2019 News Release: **Science to reveal how long highway construction should actually take**



Other Program Impact Areas – State & National Recognition

RESEARCH PAYS OFF



DamageWise Program Implementation Pays Off for Indiana



**DANIEL L. BRASSARD,
DEBORAH HORTON, AND
DARCY M. BULLOCK**

Brassard is CFO and Deputy Commissioner of Finance, Indiana Department of Transportation, Indianapolis; Horton is Managing Director, Joint Transportation Research Program (JTRC), Purdue University, West Lafayette, Indiana; and Bullock is Lyles Family Professor of Civil Engineering and JTRC Director, Purdue University, West Lafayette.

Roadway infrastructure elements, such as guardrails, signs, and bridges, routinely sustain damage from motor vehicle crashes. Recovering the costs of repairing damage to state property from the parties responsible requires efficient business processes and public agency collaboration. Indiana Department of Transportation's (DOT's) implementation of the DamageWise program increased collections for repairs to damaged state property from \$1.6 million in Fiscal Year (FY) 2010 to \$7.3 million in FY 2018. The amount invoiced in FY 2018 was \$9.0 million—an 81% collection rate.

Problem

Indiana DOT maintains approximately 11,000 miles of state roads. About 60,000 motor vehicle crashes per year occur on state-maintained roads; in approximately 4,000 instances, these crashes cause damage to state property. Indiana DOT incurs significant financial losses to repair the damage if the responsible parties cannot

be identified, if invoices do not reflect the fully loaded cost of the repair, or if collection processes are not timely and efficient.

Solution

In 2009, Indiana DOT initiated a research project through Purdue University to examine business processes related to the repair of state property damaged by motor vehicle crashes. The research was conducted between October 1, 2009, and July 31, 2011, and cost \$120,000. A review of the business processes of relevant parties—including law enforcement agencies, district maintenance departments, and collection departments—found several manual processes and often ambiguous linkages between crash reports, work orders, and damage invoices. Also conducted was a survey of other states to identify performance metrics and best practices. The Purdue-Indiana DOT research team recommendations focused on improving the efficiency and collaboration between public safety agencies and Indiana DOT when vehicle crashes damage state



Digital Highway Construction Inspection

TRB Best Paper Award

Above: Fort Wayne, Indiana.

Other Program Impact Areas – State & National Recognition



TRB Exceptional Paper Award

Using Connected Vehicle Data to Reassess Dilemma Zone Performance of Heavy Vehicles



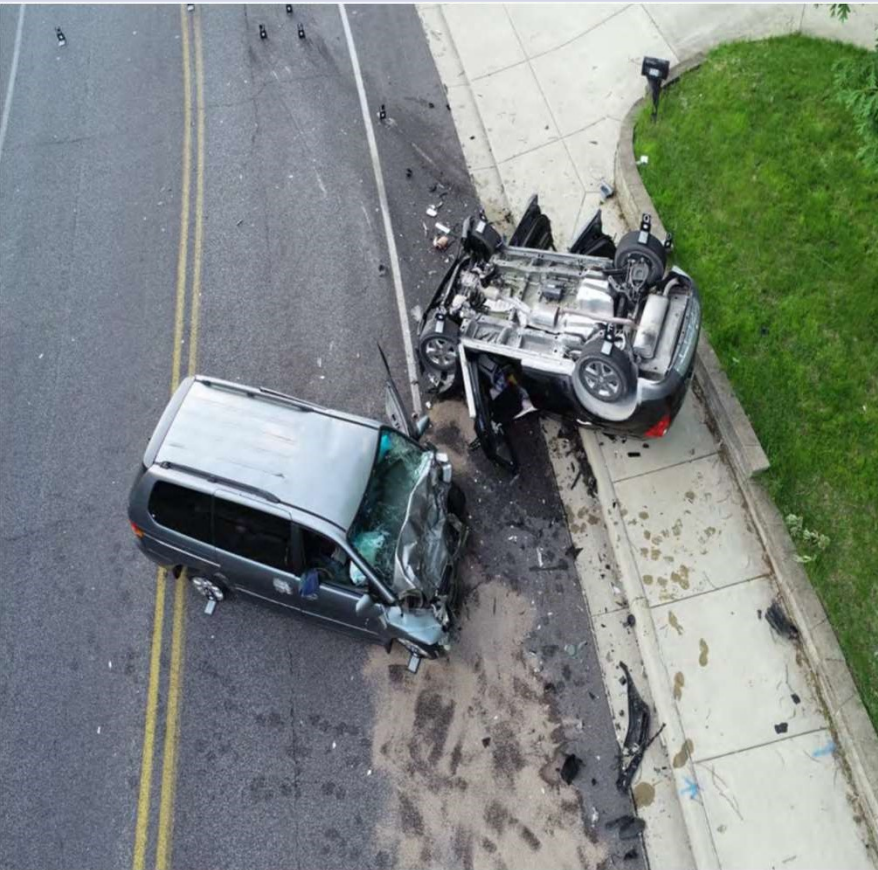
Other Program Impact Areas – State & National Recognition

Miscellaneous Research News & high profile articles

- **Mapping & Documenting Roadway crash scenes.**
- Development of an **Intelligent Snowplow Truck**, Presentation at the AASHTO Maintenance Committee Summer Meeting
- State DOT Executives Highlight Research Funding Need at House Hearing
- Idaho DOT's research project: **Evaluation of skid resistance of pavements at different speeds** (ITD 266) (INDOT R&D is selected for TAC membership).
- **FHWA Friction Management (PFM) Support Program** (INDOT is one of the four states participated in data collection)
- Selection of **INDOT staff (mainly INDOT R&D) for NCHRP projects and TRB committees.**
- These 5 states are in the best shape in 2019 (**Indiana #1**)
- Top 10 states with the best infrastructure in America (**Indiana #2**).



Other Program Impact Areas – State & National Recognition



TRB Standing Committee Members from INDOT

Dr. Prince Baah
Dr. Seonghwan Cho
Mr. Athar Khan
Mr. Jason Kruse
Dr. Jusang Lee
Dr Shuo Li
Dr. Tommy Nantung
Dr. Samy Noureldin
Ms. Anne Rearick
Mr. James Sturdevant



Other Program Impact Areas – State & National Recognition

State DOT Executives Highlight Research Funding Need at House Hearing

“The state of Indiana spent \$3.9 million on research projects in 2017 and they report that five of those research projects saved the state millions,” explained **Brian Ness**, director of the **Idaho Transportation Department**, in his [written testimony](#) before the subcommittee on research and technology. “What a great return on investment, saving 46 dollars for every one dollar spent on research!”

“States like Michigan, [Indiana](#), Ohio, and many others are using tools provided by the Strategic Highway Research Program ([SHRP2](#)), to find ways to build roads and bridges faster and more efficiently. [The money they save allows them to fund more projects](#)”.



Other Program Impact Areas – State & National Recognition

Top 10 states with the best infrastructure in America



5 states are in the best shape in 2019 and managing to stay on solid ground

2. Indiana

1. Indiana



Forensic Investigations & Specialized Testing Programs

INDOT R&D personnel collected GPR data at the Purdue Airport

Sinkhole Prompts District to Rise to the Occasion. R&D was requested to employ ground-penetrating radar (GPR) vehicle to investigate eastbound and westbound I-265.

Greenfield District recognition for INDOT R&D testing efforts on I-465, I-70, and I-65 testing in Marion County.

New Trailer Helps INDOT Get Ahead in Innovation

NDT of Bridge Decks – Impact Echo Emerging Technology – Crawfordsville District – Results & Implications

Friction and Texture Quality testing on crack sealing material to ensure the material met national specifications on the roads with the highest number of complaints of low skid resistance.

Telematics and Utilization Analytics for INDOT Mowing Operations

MCAR: Marion County Asset Recovery Program, specialized testing support

MenuBFU: environmental research resulting in coal ash and tire shed reuse specifications

Dynatest RAPTOR demo (continuous deflection testing equipment) (October 23, 2019)



Forensic Investigations & Specialized Testing Programs



Forensic Investigations & Specialized Testing Programs



You're Invited!

As the 2019 MCAR Season winds down,
it's time to celebrate!



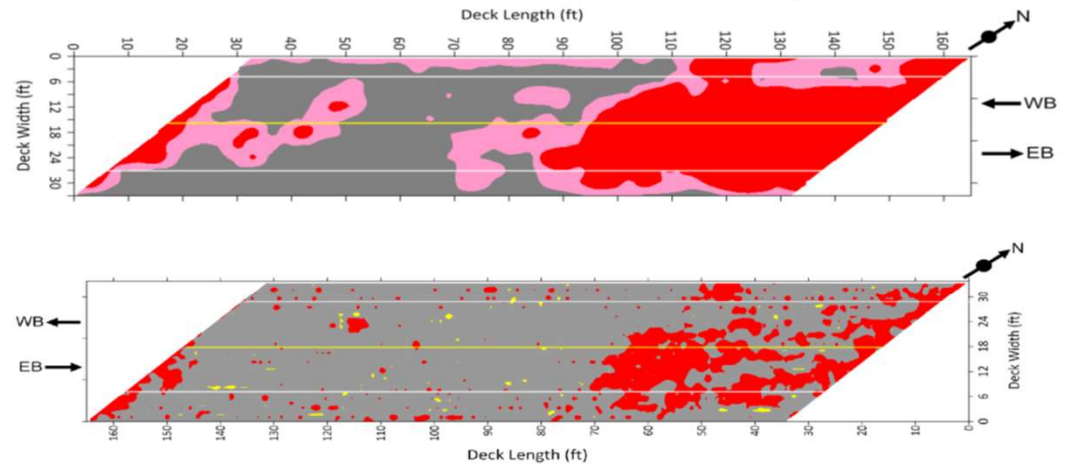
Forensic Investigations & Specialized Testing Programs



Forensic Investigations & Specialized Testing Programs



Half Cell Corrosion Potential vs. Impact Echo



Program Metrics & Venues for Continuous Improvement

Eight Objective Performance measures for INDOT Research Program;

	Description	Goal	Status
1	% Final Report submitted on time of Active Projects	>90%	92%
2	% Successful Implementation of completed projects in a FY (Conversion Rate), KPI 6	>90%	92%
3	Return on Investment in a FY (3 years Rolling Average B/C)	> 5	42
4	Percent Customer Satisfaction Score Meeting or Exceeding Expectations	> 90%	100%
5	# & Percent of Time Extensions	Specifying a Goal	Needs Improvement
6	% progress reports submitted on time	100%	100%
7	% Draft Final Report submitted on time	> 90%	94%
8	% Successful Communications	> 90%	94%



Program Metrics & Venues for Continuous Improvement

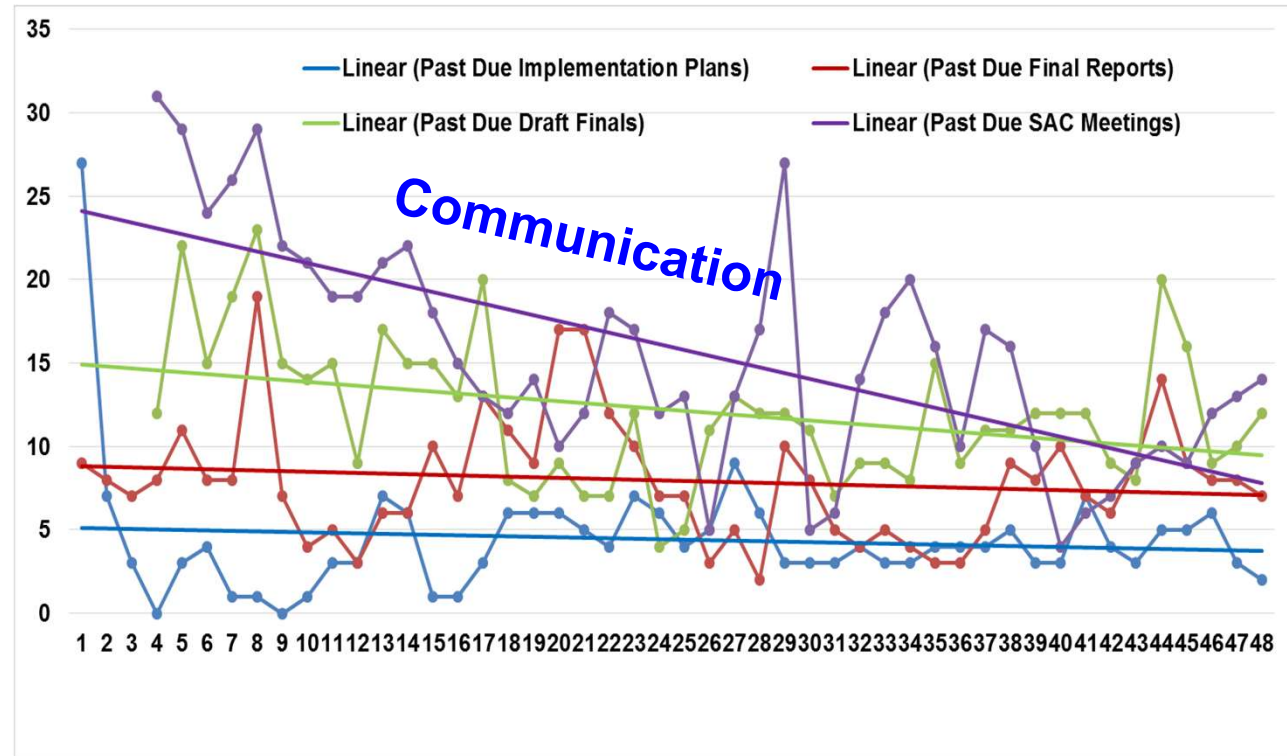
Progress of Performance Measures

Conversion Rate Based on Calendar Year (Now KPI 6)

CY	Completed Projects	Not Successfully Implemented	Conversion Rate	Goal
2012	38	6	84%	90%
2013	33	3	91%	90%
2014	19	1	95%	90%
2015	31	3	90%	90%
2016	40	2	95%	90%
2017	18	1	94%	90%
2018	27	2	93%	90%
2019	37	3	92%	90%

Conversion Rate Based on Fiscal Year

FY	Completed Projects	Not Successfully Implemented	Conversion Rate	Goal
2012	31	5	84%	90%
2013	32	3	91%	90%
2014	26	3	88%	90%
2015	24	2	92%	90%
2016	42	3	93%	90%
2017	24	0	100%	90%
2018	22	2	91%	90%
2019	34	3	91%	90%



FY 18 Research Program Benefit – Cost Analysis

❖ Projects 22

Agency B/C ratio 10:1

non-agency B/C ratio 1:1

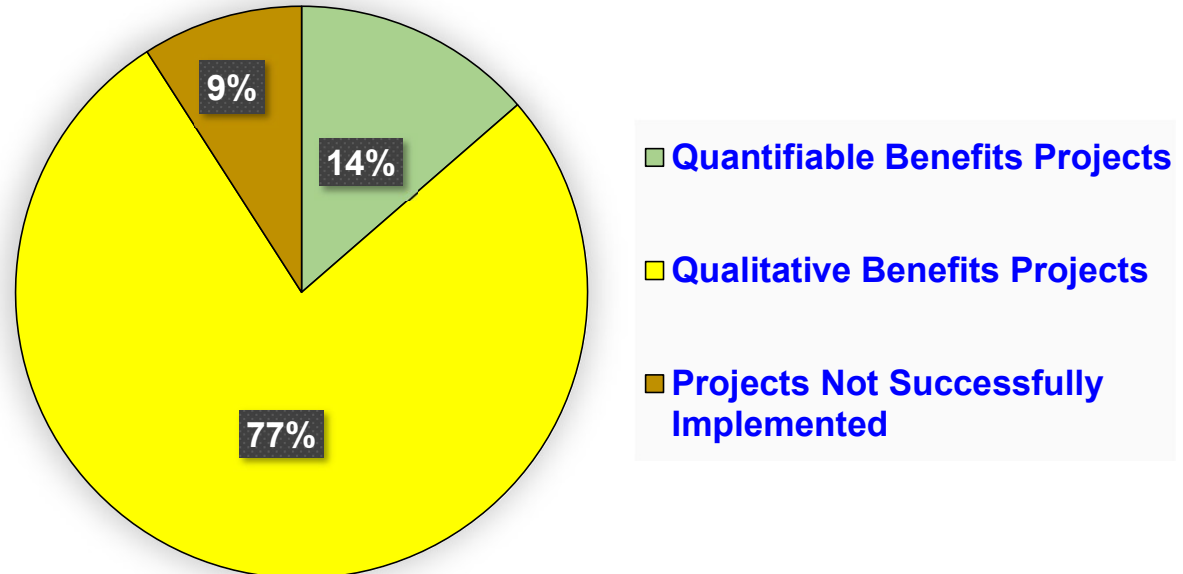
❖ 88 Projects

(Three Years Moving Average)

Agency B/C ratio 21:1

non-agency B/C ratio 21:1

Quantifiable Benefits Projects	Qualitative Benefits Projects	Projects Not Successfully Implemented
3	17	2



Program Metrics & Venues for Continuous Improvement

Linkage of **INDOT Strategic Plan** to User's Manual, Impact & ROI reports, Customer Service Surveys, Implementation Plans and Template Research Need Statements.

Mapping research projects to INDOT Strategic Plan.

Collaborate with the new **Innovation Office** for opportunities, to share current innovations and how the two offices can support each other's mission.

Explore new methods to **communicate research results and innovations using online webinars** (mirror the TRB webinar format).

FY 2020 February 13 Show Case & Peer Group meetings, focusing on focus groups to identify research needs on an ongoing basis. **FY 2021 Show case will be on February 27**. Faculty Liaisons were engaged in Focus Groups.



Program Metrics & Venues for Continuous Improvement

FY 2020, 236 research need submitted, 45 research projects funded, 23 projects completed thus far, 92 active projects.

FY 2019, 121 Research Needs submitted, 32 Research Projects funded, 34 Completed Studies, 87 active projects.

Smartsheet tracking software used for project management (active projects, needs identified, tracking implementation status).

Customer Satisfaction Performance Measures, reported to Executive Board

Annual IMPACT Report, Return on Investment (**ROI**), Conversion Rate.

User manual update.



Resources & Links

- **Indiana Government**

- www.in.gov

- **Indiana Department of Transportation, INDOT**

- www.in.gov/indot

- **INDOT Research & Development Division Contact Information**

- www.in.gov/indot/2700.htm
- Submission of Research Needs & Ideas (www.in.gov/indot/2404.htm)
- Innovative Research Needs & Ideas (www.in.gov/indot/2404.htm)
- Research Program IMPACT Report (www.in.gov/indot/2404.htm)
- Research Program Return on Investment (www.in.gov/indot/2404.htm)
- Research Program User's Manual (https://engineering.purdue.edu/JTRP/files/UsersManual_20181212)

- **Joint Transportation Research Program**

- <https://engineering.purdue.edu/JTRP>

- **Innovation Office and Submission Link (only through the intranet)**

- [https://ingov.sharepoint.com/sites/INDOTIntranet/SitePages/Innovation-at-INDOT\(2\).aspx](https://ingov.sharepoint.com/sites/INDOTIntranet/SitePages/Innovation-at-INDOT(2).aspx)

- **Testimony to the U.S. House of Representatives Committee on Science, Space, and Technology, Subcommittee on Research and Technology: “Bumper to Bumper: The Need for a National Surface Transportation Agenda”, July 11, 2019**

- <https://science.house.gov/imo/media/doc/Ness%20Testimony.pdf>

